Adopted November 13, 1986

IOWA WASTEWATER FACILITIES DESIGN STANDARDS
CHAPTER 19
SUPPLEMENTAL TREATMENT PROCESSES

Adopted November 13, 1986

IOWA WASTEWATER FACILITIES DESIGN STANDARDS
CHAPTER 19
SUPPLEMENTAL TREATMENT PROCESSES

19.1 GENERAL

19.1.1 Applicability

This chapter is applicable to construction, installation or modification of any disposal system required to obtain a construction permit from this Department under the Iowa Code, Section 455B.45, and 900 - - 64.2 of the Iowa Administrative Code (IAC).

19.1.2 Variances [900 - - 64.2 (9) “c”, “d” and “e”, IAC]

c. Variances from the design standards and siting criteria which provide, in the judgement of the department, for substantially equivalent or improved effectiveness may be requested when there are unique circumstances not found in most projects. The executive director may issue variances when circumstances are appropriate. The denial of a variance may be appealed to the commission.

d. When reviewing the variance request, the executive director may consider the unique circumstances of the project, direct or indirect environmental impacts, the durability and reliability of the alternative, and the purpose and intent of the rule or standard in question.

e. Circumstances that would warrant consideration of a variance (which provides for substantially equivalent or improved effectiveness) may include the following:

   1. The utilization of new equipment or new process technology that is not explicitly covered by the current design standards.

   2. The application of established and accepted technologies in an innovative manner not covered by current standards.

   3. It is reasonably clear that the conditions and circumstances which were considered in the adoption of the rule or standard are not applicable for the project in question and therefore the effective purpose of the rule will not be compromised if a variance is granted.

19.1.3 Explanation of Terms

The terms “shall” or “must” are used in these standards when it is required that the standard be used. Other terms such as “should” and “recommended” indicate desirable procedures or methods, which should be considered but will not be required.

19.2 PHOSPHORUS REMOVAL BY CHEMICAL TREATMENT

19.2.1 General

19.2.1.1 Method

Addition of lime or the salts of aluminum or iron may be used for the chemical removal of soluble phosphorus. The phosphorus reacts with the calcium, aluminum or iron ions to form insoluble compounds. These insoluble compounds may be flocculated with or without the addition of a coagulant aid such as a polyelectrolyte to facilitate separation by sedimentation.

19.2.1.2 Design Basis

19.2.1.2.1 Preliminary Testing

Laboratory, pilot or full-scale trial of various chemical feed systems and treatment processes are recommended to determine the achievable performance level, cost-effective design criteria, and ranges of required chemical dosages.

19.2.1.2.2 System Flexibility

Systems shall be designed with sufficient flexibility to allow for several operational adjustments in chemical feed location, chemical feed rates, and for feeding alternate chemical compounds.

19.2.2 Process Requirements

19.2.2.1 Dosage

The required chemical dosage shall include the amount needed to drive the chemical reaction to the desired state of completion plus the amount required due to inefficiencies in mixing or dispersion. Excessive chemical dosage should be avoided.

19.2.2.2 Chemical Selection

The choice of lime or the salts of aluminum or iron should be based on the wastewater characteristics and the economics of the total system.

When lime is used it may be necessary to neutralize the high pH prior to subsequent treatment in secondary biological systems or prior to discharge in those flow schemes where lime treatment is the final step in the treatment process.

19.2.2.3 Chemical Feed Points

Selection of chemical feed points shall include consideration of the chemicals used in the process, necessary reaction times between chemical and polyelectrolyte additions, and the wastewater treatment processes and components utilized.

19.2.2.4 Flash Mixing

Each chemical must be mixed rapidly and uniformly with the flow stream. Separate mixing basins equipped with mechanical mixing devices should be provided with a detention period of at least 30 seconds.

19.2.2.5 Flocculation

The particle size of the precipitate formed by chemical treatment may be very small. Consideration should be given in the process design to the addition of synthetic polyelectrolytes to aid settling. The flocculation equipment should be adjustable in order to obtain optimum floc growth, control deposition of solids, and prevent floc destruction.

19.2.2.6 Liquid – Solids Separation

The velocity through pipes or conduits from flocculation basins to settling basins should not exceed 1.5 feet per second in order to minimize floc destruction. Entrance works to settling basins should also be designed to minimize floc shear.

Settling basin design shall be in accordance with criteria outlined in Chapter 16. For design of the sludge handling system, special consideration should be given to the type and volume of sludge generated in the phosphorus removal process.

19.2.2.7 Filtration

Effluent filtration shall be considered where effluent total phosphorus concentrations of less than 1 mg/1 must be achieved.

19.2.3 Feed Systems

19.2.3.1 Location

All liquid chemical mixing and feed installations shall be installed on corrosion resistant pedestals elevated above the floor level for ease of cleaning.

Lime feed equipment shall be located so as to minimize the length of slurry conduits. All slurry conduits shall be accessible for cleaning.

19.2.3.2 Liquid Chemical Feed System

Liquid chemical feed pumps shall be of the positive displacement type with variable feed rate. Pumps shall be selected to feed the full range of chemical quantities required for the phosphorus mass loading conditions anticipated with the largest unit out of service.

Screens and valves shall be provided on the chemical feed pump suction lines.

An air break or anti-siphon device shall be provided where the chemical solution stream discharges to the transport water stream to prevent an induction effect resulting in overfeed.

Consideration shall be given to providing pacing equipment to optimize chemical feed rates.

19.2.3.3 Dry Chemical Feed System

Each dry chemical feeder shall be equipped with a dissolver which is capable of providing a minimum 5-minute retention at the maximum feed rate.

Polyelectrolyte feed installations shall be equipped with two solution vessels and transfer piping for solution make-up and daily operation.

Make-up tanks shall be provided with an eductor funnel or other appropriate arrangement for wetting the polymer during the preparation of the stock feed solution. Adequate mixing shall be provided by a large-diameter low-speed mixer.

19.2.4 Storage Facilities

19.2.4.1 Size

Storage facilities shall be sufficient to insure that an adequate supply of the chemical is available at all times. Exact size required will depend on size of shipment, length of delivery time, and process requirements. Storage for a minimum of 10-days supply shall be provided.

19.2.4.2 Location

The liquid chemical storage tanks and tank fill connections shall be located within a containment structure having a capacity exceeding the total volume of all storage vessels. Valves on discharge lines shall be located adjacent to the storage tank and within the containment structure. Containment areas shall be sloped to a sump area and shall not contain floor drains.

Bag storage shall be located near the solution make-up point to avoid unnecessary transportation and housekeeping problems.

19.2.4.3 Accessories

Platforms, ladders and railings shall be provided as necessary to afford convenient and safe access to all filling connections, storage tank entries, and measuring devices.

Storage tanks shall have reasonable access provided to facilitate cleaning.

19.2.5 Other Requirements

19.2.5.1 Materials

All chemical feed equipment and storage facilities shall be constructed of materials resistant to chemical attack by all chemicals normally used for phosphorus treatment.

19.2.5.2 Temperature, Humidity and Dust Control

Precautions shall be taken to prevent chemical storage tanks and feed lines from reaching temperatures likely to result in freezing or chemical crystallization at the concentrations employed. A heated enclosure or insulation may be required. Provisions shall be made for temperature, humidity and dust control in all chemical feed room areas.

19.2.5.3 Cleaning

Consideration shall be given to the accessibility of piping. Piping shall be installed with plugged wyes, tees or crosses at changes in direction to facilitate cleaning.

19.2.5.4 Drains and Drawoff

Above-bottom drawoff from chemical storage or feed tanks shall be provided to avoid withdrawal of settled solids into the feed system. A bottom drain shall also be installed for periodic removal of accumulated settled solids.

19.2.6 Sludge Handling

19.2.6.1 General

Provisions shall be made for the type and additional capacity of the sludge handling facilities needed when chemicals are added.

19.2.6.2 Dewatering

Design of dewatering systems shall be based, where possible, on an analysis of the characteristics of the sludge to be handled. Consideration shall be given to the ease of operation, effect of recycle streams generated, production rate, moisture content, dewatering, final disposal, and operating cost.

19.3 HIGH RATE EFFLUENT FILTRATION

19.3.1 General

19.3.1.1 Applicability

Granular media filters may be used as a tertiary treatment device for the removal of residual suspended solids from secondary effluents. Where effluent suspended solids requirements are less than 10 mg/1, where secondary effluent quality can be expected to fluctuate significantly, or where filters follow a treatment process where significant amounts of algae will be present, a pre-treatment process such as chemical coagulation and sedimentation or other acceptable process should precede the filter units.

19.3.1.2 Design Considerations

Care should be given in the selection of pumping equipment ahead of filter units to minimize shearing of floc particles. Consideration should be given in the plant design to providing flow-equalization facilities to moderate filter influent quality and quantity.

19.3.1.3 Filter Types

Filters may be of the gravity type or pressure type. Pressure filters shall be provided with ready and convenient access to the media for treatment or cleaning. Where greases or similar solids, which result in filter plugging are expected, filters should be of the gravity type.

19.3.3 Filtration Rates

19.3.3.1 Allowable Rates

Filtration rates shall not exceed 5 gpm/sq. ft. based on the maximum hydraulic flow rate applied to the filter units.

19.3.3.2 Number of Units

Total filter area shall be provided in 2 or more units, and the filtration rate shall be calculated on the total available filter area with one unit out of service.

19.3.4 Backwash

19.3.4.1 Backwash Rate

The backwash rate and procedure shall be appropriate for the filter media used, with fluidization capability or other means provided for dual or triple media filters to permit restratification of the layers in their desired positions at the end of the backwash. The backwash system shall be capable of providing a variable backwash rate having a maximum of at least 20 gpm/sq. ft. and a minimum backwash period of 10 minutes.

19.3.4.2 Backwash

Pumps for backwashing filter units shall be sized and interconnected to provide the required rate to any filter with the largest pump out of service. Filtered water shall be used as the source of backwash water. Waste filter backwash shall be returned to the plant influent for further treatment.

19.3.5 Filter Media

Selection of proper media size and type will depend on the filtration rate selected; the type of treatment provided prior to filtration, filter configuration, and effluent quality objectives. In dual or multi-media filters, media size selection must consider compatibility among media.

The media size and depth shall be selected to provide an effluent meeting the specific conditions and treatment requirements relative to the project under consideration. Furthermore, the head loss provided shall be appropriate for the media to ensure that the backwash volume required does not exceed 10 percent of the plant production when the plant is at design capacity.

19.3.6 Filter Appurtenances

The filters shall be equipped with washwater troughs, overflow troughs or a central gullet, surface wash or air scouring equipment, means of measurement and positive control of the backwash rate, equipment for measuring filter head loss, positive means of shutting off flow to a filter being backwashed, and filter influent and effluent sampling points. If automatic controls are provided, there shall be a manual override for operating equipment, including each individual valve essential to the filter operation. The underdrain system shall be designed for uniform distribution of backwash water (and air, if provided) without danger of clogging from solids in the backwash water. Provision shall be made to allow periodic chlorination of the filter influent or backwash water to control slime growths.

19.3.7 Access and Housing

Each filter unit shall be designed and installed so that there is ready and convenient access to all components and the media surface for inspection and maintenance without taking other units out of service. Housing shall be provided for all filter units and all controls shall be enclosed. The structure housing filter controls and equipment shall be provided with adequate heating and ventilation equipment to minimize problems with excess humidity.

19.3.8 Backwash Surge Control

The rate of return of waste filter backwash water to treatment units shall be controlled such that the rate does not exceed 15 percent of the design average daily flow rate to the treatment units. The hydraulic and organic load from waste backwash water shall be considered in the overall design of the treatment plant. Where waste backwash water is returned for treatment by pumping, adequate pumping capacity shall be provided with the largest unit out of service.

19.3.9 Backwash Water Storage

Total backwash water storage capacity provided in an effluent clearwell or other unit shall equal or exceed the volume required for two complete backwash cycles although additional capacity shall be considered to allow for operational flexibility.

19.3.10 Proprietary Equipment

Where proprietary filtration equipment, such as shallow bed, traveling bridge, continuous backwash type filters, is proposed, data which supports the capability of the equipment to meet effluent requirements under design conditions shall be provided to the department for review on a case-by-case basis.

19.4 OTHER SUPPLEMENTAL TREATMENT PROCESSES

Other supplemental treatment processes, such as dissolved oxygen adjustment, pH adjustment, carbon absorption, denitrification processes, biological phosphorus removal systems and other advanced treatment processes are available but have not been discussed in detail in this standard. This does not preclude design engineers from submitting proposals for the application of such technologies where they may seem to offer appropriate solutions to wastewater treatment problems. After experience is gained with the use of such systems, consideration may be given to incorporating more detailed information in future revisions to these standards.

Microscreening has not been included in this standard because of many design, construction and operational problems which were reported on as a result of a preliminary assessment of several problem projects by the Environmental Protection Agency. The projects pertained to microscreening of pond effluents, but some of the problems could be expected on other type installations. Screen units have been redesigned and performance evaluations are being conducted but the results for the redesigned units are not yet available.